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# CHAPTER 1

# LINEAR EQUATIONS AND MATHEMATICAL CONCEPTS

## EXERCISES 1.1

**1.** $3x + 1 = 4x - 5$

$1 = x - 5$

$x = 6$ conditional equation

**3.** $5(x + 1) + 2(x - 1) = 7x + 6$

$5x + 5 + 2x - 2 = 7x + 6$

$7x + 3 = 7x + 6$ contradiction

**5.** $4(x + 3) = 2(2x + 5)$

$4x + 12 = 4x + 10$ contradiction

*Solutions Manual to Accompany Finite Mathematics: Models and Applications*, First Edition.
Carla C. Morris and Robert M. Stark.

**7.** $5x - 3 = 17$

$5x = 20$

$x = 4$

**9.** $2x = 4x - 10$

$2x - 4x = -10$

$-2x = -10$

$x = 5$

**11.** $4x - 5 = 6x - 7$

$-5 + 7 = 6x - 4x$

$2 = 2x$

$1 = x$

**13.** $0.6x = 30$

$x = 30/0.60 = 50$

**15.** $2/3 = (4/5)x - (1/3)$ multiply by 15 to eliminate fractions

$1(2/3) = 15\{(4/5)x - (1/3)\}$

$10 = 12x - 5$

$15 = 12x$

$5/4 = x$

**17.** $5(x - 4) = 2x + 3(x - 7)$

$5x - 20 = 2x + 3x - 21$

$5x - 20 = 5x - 21$

No solution

**19.** $3s - 4 = 2s + 6$

$s - 4 = 6$

$s = 10$

**21.** $7t + 2 = 4t + 11$

$7t - 4t = 11 - 2$

$3t = 9$

$t = 3$

**23.** $4(x + 1) + 2(x - 3) = 7(x - 1)$

$4x + 4 + 2x - 6 = 7x - 7$

$6x - 2 = 7x - 7$

$6x - 7x = -7 + 2$

$x = -5$

$x = 5$

**25.** $\dfrac{x + 8}{2x - 5} = 2$ multiply by $2x - 5$ to eliminate the fraction

$(x + 8) = 2(2x - 5)$

$x + 8 = 4x - 10$

$8 + 10 = 4x - x$

$18 = 3x$

$6 = x$

(Check the result. Multiplication by a factor such as $2x - 5$ can introduce an extraneous solution.)

**27.** $8 - \{4[x - (3x - 4) - x] + 4\} = 38 - \{4[x - (3x - 4) - x] + 4\}$

$= 3(x + 2)$

$8 - \{4[x - 3x + 4 - x] + 4\} = 3x + 6$

$8 - \{4[-3x + 4] + 4\} = 3x + 6$

$8 - \{-12x + 16 + 4\} = 3x + 6$

$8 - \{-12x + 20) = 3x + 6$

$8 + 12x - 20 = 3x + 6$

$12x - 12 = 3x + 6$

$9x = 18$

$x = 2$

**29.** $6x - 3y = 9$ for $x$

$$6x = 3y + 9$$

$$x = \frac{3y+9}{6} = \frac{1}{2}y + \frac{3}{2}$$

**31.** $3x + 5y = 15$

$$5y = 15 - 3x$$

$$y = \frac{(15 - 3x)}{5}$$

$$y = 3 - \left(\frac{3}{5}\right)x$$

**33.** $V = LWH$

$$\frac{V}{LH} = W$$

**35.** $Z = \dfrac{(x - \mu)}{\sigma}$

$$Z\sigma = x - \mu$$

$$x = Z\sigma + \mu$$

**37.** Let $x$ = monthly installment (\$).
Since Sally paid \$300 down, she owes \$1300 – \$300 = \$1000.
Therefore, $5x = 1000$ or $x = \$200$ is the monthly installment.

**39.** The consumption function is $C(x) = mx + b$. The slope is the "marginal propensity to consume." Therefore, $C(x) = 0.75x + b$. The disposable income, $x = 2$, when consumption is $y = 11$ yields $11 = (0.75)(2) + b$ and $b = 9.5$. The consumption function is $C(x) = 0.75x + 9.5$.

**41.** a) $d = 4.5(2) = 9$ miles
b) $18 = 4.5t$ and $t = 18/4.5 = 4$ seconds

**43.** The tax is 6.2% or 0.062 in decimal form, so $T = 0.062x$, where $x$ is $0 \le x \le 87{,}000$.

**45.** a) BSA = 1321 + (0.3433)(20,000) = 8187 $\text{cm}^2$
b) 10,325 = 1321 + (0.3433)(Wt)
9004 = (0.3433)(Wt)
9004/0.3433 = 26,228 g = 26.2 kg

## EXERCISES 1.2

**1.** Setting $y = 0$ determines the $x$-intercept and setting $x = 0$ determines the $y$-intercept.

a) $5x - 3y = 15$ — $x$-intercept 3, $y$-intercept $-5$

b) $y = 4x - 5$ — $x$-intercept 5/4, $y$-intercept $-5$

c) $2x + 3y = 24$ — $x$-intercept 12, $y$-intercept 8

d) $9x - y = 18$ — $x$-intercept 2, $y$-intercept $-18$

e) $x = 4$ — $x$-intercept 4, no $y$-intercept(vertical line)

f) $y = -2$ no — $x$-intercept (horizontal line), $y$-intercept $-2$

**3.** The slope is $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

a) (3, 6) and (−1, 4) $\quad m = \dfrac{4-6}{-1-3} = \dfrac{-2}{-4} = \dfrac{1}{2}$

b) (1, 6) and (2, 11) $\quad m = \dfrac{11-6}{2-1} = \dfrac{5}{1} = 5$

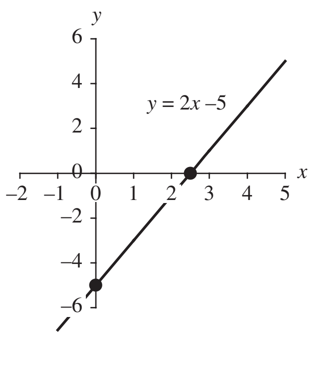
c) (6, 3) and (12, 7) $\quad m = \dfrac{7-3}{12-6} = \dfrac{4}{6} = \dfrac{2}{3}$

d) (2, 3) and (2, 7) $\quad m = \dfrac{7-3}{2-2} = \dfrac{4}{0}$ undefined

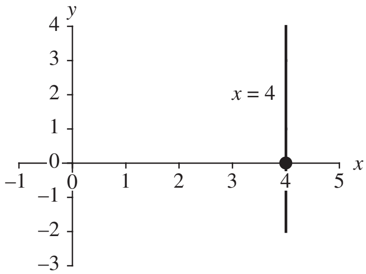
e) (2, 6) and (5, 6) $\quad m = \dfrac{6-6}{5-2} = \dfrac{0}{3} = 0$

f) (5/3, 2/3) and (10/3, 1) $\quad m = \dfrac{1 - {}^2\!/_3}{{}^{10}\!/_3 - {}^5\!/_3} = \dfrac{{}^1\!/_3}{{}^5\!/_3} = \dfrac{1}{5}$

**5.** a) $x$-intercept 5/2 and $y$-intercept $-5$




b) $x$-intercept 4 and no $y$-intercept

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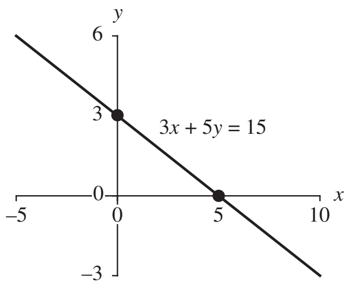
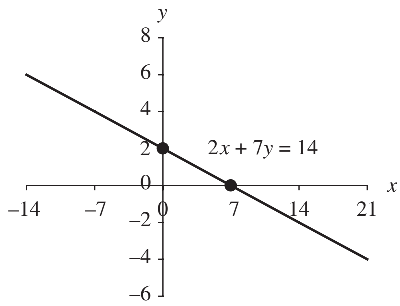
c) $x$-intercept 5 and $y$-intercept 3




d) $x$-intercept 7 and $y$-intercept 2




**7.** a) $y = (5/3)x + 2$ and $5x - 3y = 10$; the slope of the first line is 5/3. Solving for $y$ in the second equation yields $y = (5/3)x - (10/3)$. This slope is also 5/3. The slopes are both (5/3) so the lines are parallel (with different intercepts).

b) $6x + 2y = 4$ and $y = (1/3)x + 1$. The slope of the second line is easily determined (line in slope intercept form) as 1/3. Again, solve for $y$ in the first equation to determine $y = -3x + 2$. The slope is $-3$. The slopes are negative reciprocals; the lines are perpendicular.

c) $2x - 3y = 6$ and $4x - 6y = 15$. Solving for y in each equation, one determines that $y = (2/3)x - 2$ and $y = (2/3)x - (5/2)$. These lines have the same slope (and different intercepts) making them parallel.

d) $y = 5x - 4$ and $3x - y = 4$. The slope of the first line is 5 and solving for $y$ in the second equation, $(y = 3x - 4)$, the slope is 3. These slopes are neither the same nor negative reciprocals. They are neither parallel nor perpendicular.

e) $y = 5$ is a horizontal line while $x = 3$ is a vertical line. The two lines are perpendicular.

**9.** A linear equation has a single $x$-intercept except for $y = 0$ (the $x$-axis) with an infinite number of $x$-intercepts. Any horizontal line except $y = 0$ has no $x$-intercepts. Generally, lines do not have more than one $y$-intercept. The exception is $x = 0$ (the $y$-axis) with an infinite number of $y$-intercepts. Any vertical line with the exception of $x = 0$ has no $y$-intercepts.

**11.** The ordered pairs of "time" and "machine value" are (0, 75,000) and (9, 21,000), respectively. The slope is

$m = \frac{21{,}000 - 75{,}000}{9 - 0} = \frac{-54{,}000}{9} = -6000$. The $y$-intercept is the purchase price, \$75,000. The equation to model the straight-line depreciation is $V(t) = -6000t + 75{,}000$, where $V(t)$ is the machine value (\$) at time $t$.

**13.** The ordered pairs (gallons, miles) are (7, 245) and (12, 420).

The slope is $\frac{420 - 245}{12 - 7} = \frac{175}{5} = 35$ with $x$ gallons and $y$ miles.

Use either pair with the point slope-formula.

Therefore, $y - 245 = 35(x - 7)$ or $y = 35x$.

**15.** Total cost reflects both fixed and variable costs. The fixed cost is monthly rent (\$1100). The variable cost is $5x$, where $x$ is monthly production. Therefore, total cost is $C(x) = 1100 + 5x$.

**17.** a) Here, the fixed cost is \$50/day and variable cost \$0.30/mile. To rent the car for a single day costs \$50 to which the mileage cost must be added. The cost is $C(x) = 50 + 0.30x$.

b) If a person has \$110 for rental, the equation to solve for the travel distance is $110 = 50 + 0.30x$.
Solving yields,

$$60 = 0.30x$$
$$\frac{60}{0.30} = x$$
$$200 = x$$

The person can rent the car and travel 200 miles with \$110.

**19.** Since $R$ is to be a function of $C$, the ordered pairs are $(C, R)$. The two ordered pairs are (70, 84) and (40, 48). The slope is $\frac{48 - 84}{40 - 70} = \frac{36}{30} = \frac{6}{5}$. Using either pair with the slope to yield $R - 84 = (6/5)(C - 70)$ or $R = (6/5)C$.